

Fletcher, Heald & Hildreth, P.L.C.
1300 North 17th Street 11th floor
Arlington VA 22209
703-812-0400 (voice)
703-812-0486 (fax)

MITCHELL LAZARUS
703-812-0440
LAZARUS@FHHLAW.COM

November 30, 2001

Ms. Magalie Salas, Secretary
Federal Communications Commission
445 12th Street SW
Washington DC 20554

**Re: ET Docket No. 98-153, Revision of Part 15 of the Commission's Rules
Regarding Ultra-Wideband Transmission Systems
*Ex parte Communication***

Dear Ms. Salas:

On behalf of XtremeSpectrum, Inc., and pursuant to Section 1.1206(b)(1) of the Commission's Rules, I am attaching two documents that John McCorkle of XtremeSpectrum provided yesterday to Michael J. Marcus of the Office of Engineering and Technology.

If there are any questions about this filing, please call me at the number above.

Respectfully submitted,

Mitchell Lazarus

Mike,

Below are the equations we derived following the alternate approach you outlined for us – an alternate way of computing the plots in slide 56 of our Nov 26 Ex Parte filing which was done using the NTIA's spreadsheet. According to our calculations, the results between the two methods agree within about 1 dB, which I think is about the same as you are getting. The small difference has to do with the antenna pattern which was slightly different between the V/m calculation and the I/N calculation. Clearly, the method below eliminates the possibility of even making this error because the antenna pattern is mathematically eliminated all together. *Also SAE J1113/1 says 100V/m is limit for vehicles.*

--For the Interference at the UWB device--

W/m^2 (at UWB receiver) = $\frac{P_t G_t}{4\pi R^2}$ where P_t and G_t are the power and antenna gain of the radar and R

is range in meters. Converting to dB we have

$$\begin{aligned} dB W/m^2 &= 10\log(P_t) + 10\log(G_t) - 20\log(R) - 10\log(4\pi) \text{ or if we assume the parameters are in dB, then} \\ &= P_t + G_t - L_p - C_1 \end{aligned}$$

--For the Interference at the Radar--

$$\frac{I(\text{watts of UWB at radar receiver})}{N(\text{watts of noise at receiver input})} = \frac{P_u B A_e}{4\pi R^2 K(T_0 + T_r) B} = \frac{P_u}{4\pi R^2 K(T_0 + T_r)} \frac{G_t I^2}{4\pi} = \frac{P_u G_t}{(4\pi R)^2 K(T_0 + T_r)} \left(\frac{c}{f}\right)^2$$

where P_u is the UWB power in W/Hz, B is the radar receiver bandwidth in Hertz, T_0 is 290 degrees that the antenna is looking at on the low beam, T_r is the equivalent noise temperature of the entire radar receiver (ignoring clutter), and we assume the UWB is transmitting out of an isotropic antenna.

Converting to dB as before we get:

$$\begin{aligned} dB(I/N) &= 10\log(P_u) + 10\log(G_t) - 20\log(R) - 20\log(4\pi) - 20\log(f/c) - 10\log(K(T_0 + T_r)) \\ &= P_u + G_t - L_p - 2C_1 - A(f) - N \end{aligned}$$

-- Now taking the ratio (subtracting in dB) we get--

$P_t - P_u + C_1 + A + N$ or, not in dB we get

$$\frac{W/m^2 \text{ (at UWB receiver)}}{I/N \text{ (at radar receiver)}} = \frac{P_t 4\pi}{P_u} \left(\frac{f}{c}\right)^2 K(T_0 + T_r) \text{ where } T_r = 290 \left(10^{\frac{NF}{10}} - 1\right) \text{ and NF is the}$$

effective noise figure for the entire radar receiver system (not just the LNA).

To convert from watts to volts we have $V/m = \sqrt{376.7 \cdot W/m^2}$

So writing it as V/m we get

$$V/m \text{ (at UWB receiver)} = \sqrt{I/N \text{ (at radar receiver)} \frac{P_t 4\pi}{P_u} \left(\frac{f}{c}\right)^2 K(T_0 + T_r) \cdot 376.7}$$

Writing this in a convenient dB form with a single "junk" constant, we get:

$$dB(V/m) \text{ (at UWB receiver)} = .5 \left[\begin{aligned} &10\log(I/N) + 10\log(P_t) - 10\log\left(\frac{P_u}{10^9}\right) + 10\log(f^2 \cdot 10^{18}) \\ &+ 10\log(T_0 + T_r) + 10\log\left(4\pi \frac{376.7 \cdot K \cdot 10^{27}}{c^2}\right) \end{aligned} \right]$$

Now converting back to get our plot with V/m versus dB(I/N)

$$V/m \text{ (at UWB receiver)} = 10^{\frac{I/N(dB) + P_t(dBW) - P_u(dBm/MHz) + f(dB-GHz^2) + T(dB^\circ K) - 91.38}{20}}$$

$$\frac{\frac{P_t \cdot G_t}{4 \cdot \pi \cdot R^2}}{\left[\frac{P_u \cdot G_t \cdot c^2}{(4 \cdot \pi \cdot R)^2 \cdot K \cdot (T_o + T_r) \cdot f^2} \right]} = 4 \cdot P_t \cdot \frac{\pi}{(P_u \cdot c^2)} \cdot K \cdot (T_o + T_r) \cdot f^2$$

$$NF := 3.6$$

$$T_o := 290$$

$$c := 2.997925 \cdot 10^8$$

$$K := 1.38 \cdot 10^{-23}$$

$$P_t := 93 \cdot 10^3$$

$$dBwPt := 10 \cdot \log(P_t)$$

$$f := 1.25 \cdot 10^9$$

$$dBf := 20 \cdot \log\left(\frac{f}{10^9}\right)$$

$$dBf = 1.938$$

$$dBmPu := -41.3 - 12$$

$$P_u := 10^{\frac{dBmPu - 30 - 60}{10}}$$

$$P_u = 4.677 \times 10^{-15}$$

$$N := 128$$

$$T_r := 290 \cdot \left(10^{\frac{NF}{10}} - 1\right)$$

$$dBT := 10 \cdot \log(T_r + T_o)$$

$$dBT = 28.224$$

$$T_r = 374.352$$

$$i := 0..N - 1$$

$$dBIN_i := \left(i - \frac{N - 1}{1.1}\right) \cdot .5$$

$$C := 10 \cdot \log\left[\frac{4 \cdot \pi \cdot 377 \cdot K \cdot 10^{18} \cdot 10^9}{(c)^2}\right]$$

$$C = -91.382$$

$$IN := 10^{\frac{dBIN}{10}}$$

$$V_m := 10^{\frac{dBIN + dBwPt - dBmPu + dBf + dBT + C}{20}}$$

$$V_{m2} := \sqrt{\frac{IN \cdot 4 \cdot \pi \cdot P_t}{(P_u \cdot c^2)} \cdot K \cdot (T_o + T_r) \cdot f^2 \cdot 377}$$

